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Metacognition is Necessary for the Emergence of Motivation in People with Schizophrenia Spectrum Disorders: A Necessary Condition Analysis

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Abstract

Metacognition deficits are a putative cause of reduced motivation in people with schizophrenia spectrum disorders. However, it is unclear whether certain levels of metacognition are necessary for motivation to emerge. This study used a Necessary Condition Analysis (NCA) to test whether metacognition was necessary for the presence of motivation and to identify the minimum level of metacognition necessary for high motivation to be possible in people with schizophrenia spectrum disorders (N=175). Participants completed clinician-rated measures of metacognition and motivation. NCA revealed that metacognition is a necessary condition for motivation and that high levels of motivation were only possible, although not guaranteed, when at least a basic level of metacognition was present. Findings suggest that metacognition is a necessary building block for the development of motivation. Results suggest that targeting metacognition may be essential for improving motivation among people with schizophrenia spectrum disorders who do not meet this metacognition threshold.

Keywords

Metacognition; motivation; schizophrenia; psychosis; apathy

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Introduction

Motivation—an internal state that initiates, directs, and maintains goal-directed behavior (Kleinginna Jr et al., 1981)—is one of the strongest determinates of functioning in people with schizophrenia spectrum disorders (Fervaha et al., 2014; Foussias et al., 2009). Although some promising treatments have led to improvements in motivation (Fiszdon et al., 2016; Grant et al., 2012), people in early and late phases of psychosis often struggle with reduced motivation (Fervaha et al., 2015a; Luther et al., 2015a). Thus, in an effort to increase our understanding and identify novel treatment targets to enhance motivation, researchers have turned to examining the underlying mechanisms of motivation among people with schizophrenia spectrum disorders.

Metacognition, or the capacity to identify and then integrate mental experiences such as thoughts and emotions into complex representations of oneself and others (Lysaker et al., 2015; Semerari et al., 2003), has been identified as a potential cause of motivation in people with schizophrenia spectrum disorders. To date, studies have established cross-sectional associations between increased metacognition and motivation (Luther et al., 2016a; Tas et al., 2012). Increased motivation has also been found to mediate the relationship between greater metacognition and functioning in people with schizophrenia spectrum disorders (Luther et al., 2016b). Further, small longitudinal studies have identified that greater metacognition is a significant predictor of improved motivation over six months (Luther et al., 2016a; Vohs et al., 2014).

The established link between metacognition and motivation raises the question of whether certain levels of metacognition are needed for motivation to emerge among people with schizophrenia spectrum disorders. Theoretically, some level of metacognition is necessary for goal-directed behavior. At a basic level, the awareness of intentions or internal states such as pleasure is important for guiding task selection. Further, without an ability to identify and differentiate between thoughts, it may be hard to question inaccurate or maladaptive thoughts about oneself, others, or the world that can impede motivation. Having an integrated understanding of oneself also supports a person’s ability to make meaning of their lives and to identify the value of a task or goal. Similarly, if one does not have an integrated understanding of oneself, it may be difficult to accurately weigh the costs and benefits of completing a task. Therefore, it is likely that some minimum level of metacognition must be present for motivation to develop, or in other words, that metacognition is a necessary condition for motivation. However, metacognition is likely not completely sufficient for the emergence of motivation, as other factors such as personality (Vohs et al., 2013), basic psychological needs (Gard et al., 2014; Ryan et al., 2000), and expectations about self and others (Luther et al., 2015b; Thomas et al., 2016) also impact motivation in people with schizophrenia spectrum disorders. Thus, it is likely that metacognition is a necessary but not sufficient condition for motivation, or more specifically, that minimum levels of metacognition must be present in order for increased levels of motivation to occur but do not guarantee that high levels of motivation will emerge. Alternatively, without the presence of these minimum levels of metacognition, higher levels of motivation are guaranteed not to occur, regardless of the presence of other factors that may improve motivation (Dul, 2016b).

Extant empirical evidence also suggests that certain levels of metacognition may be needed in order for higher levels of motivation to be possible among people with schizophrenia spectrum disorders. Specifically, over six months, Vohs & Lysaker (2014) found that participants with low and moderate levels of mastery, a domain of metacognition, had similar levels of motivation, but those with higher levels of mastery had relatively higher motivation, suggesting there might be a certain level of metacognition needed to develop high motivation. A separate study also found that increased levels of overall metacognition predicted improved motivation six months later (Luther et al., 2016a). However, these prior studies were only able to identify whether on average, higher levels of metacognition lead to higher levels of motivation—not whether a *minimum* level of metacognition is needed for *specific* levels of motivation to be possible (Dul, 2016b). Elucidating whether and what level of metacognition is necessary for the presence of specific levels of motivation may clarify the importance of targeting metacognition to enhance motivation within psychosocial interventions and help to identify people who may see the most improvement in motivation if metacognition is targeted.

The current study sought to test two aims. First, using a novel statistical approach—a Necessary Condition Analysis (Dul, 2016b; Dul et al., 2010)—we tested our hypothesis that overall metacognition is necessary to enable motivation in people with schizophrenia spectrum disorders. If overall metacognition was found to be a necessary condition for motivation, to aid with interpretation and clinical utility, we then explored the minimum level of overall metacognition that had to be present in order for high motivation to be possible in a sample of 175 people with a schizophrenia spectrum disorder. If a necessary condition was present for the overall metacognition score, we explored whether individual metacognition domains were also necessary conditions.

Methods

Participants

Participants were 175 people with a Structured Clinical Interview for Diagnosis (SCID-IV (First et al., 2002) confirmed diagnosis of schizophrenia (n = 110, 63%) or schizoaffective disorder (n = 65, 37%). Recruitment occurred at a Veterans' Affairs Medical Center and a community mental health center. Eligibility criteria included being an adult (i.e., ≥ 18 years old) in a post-acute phase of illness as defined by no hospitalizations or changes in housing or medication within 30 days of study enrollment. Exclusion criteria included the presence of a developmental disability or organic brain disease, which were determined through a chart review and the study interview. Included participants had a mean age of 48.67 (SD = 9.90) and were primarily male (n = 153, 87%) and African American (n = 97, 55%) with an average of 12.74 ($SD = 2.12$) years of education. Of note, although we have previously presented regression-based analyses with metacognition and motivation (Luther et al., 2016b), this is the first study to explicitly test whether specific levels of metacognition are needed for motivation to emerge.

Measures

Metacognition—The Metacognition Assessment Scale—Abbreviated (MAS-A; Lysaker et al., 2005) was used to assess metacognition. To complete the MAS-A, a trained interviewer first engages participants in a semi-structured interview, the Indiana Psychiatric Illness Interview (IPII; Lysaker et al., 2002), that asks open-ended questions inviting participants to share narratives regarding: 1) their life narrative, 2) whether they think they have a mental illness, and if so, the ways it has impacted their life 3), whether and how their illness controls their life and how they control their illness, 4) how their illness impacts and is impacted by people, and 5) what they see for themselves in the future. Responses are recorded, transcribed, de-identified, and then rated using the MAS-A, which was modified from the Metacognition Assessment Scale (Semerari et al., 2003). The MAS-A contains four subscales: 1) *self-reflectivity* or being aware of and differentiating one's mental states (score range 0 – 9), 2) *awareness of the other's mind* or recognizing and distinguishing between the mental states of others (range 0 – 7), 3) *decentration* or understanding that events can be viewed from different perspectives (range 0 – 3), and 4) *mastery* or integrating knowledge of oneself and others' mental states and using this information to respond to psychological and social challenges (range 0 – 9). Each subscale is scored on half point increments, and higher scores on each subscale reflect greater capacity to engage in increasingly complex metacognitive acts within each subscale. Subscales can also be summed to create a total MAS-A score (range 0 – 28). The MAS-A has demonstrated strong inter-rater reliability (Lysaker et al., 2005; Rabin et al., 2014) and convergent validity with measures of cognitive and clinical insight (Lysaker et al., 2005; Lysaker et al., 2008).

Motivation—Based on the work of Nakagami, Xie, Hoe, & Brekke (2008), motivation was assessed using the sum of the sense of purpose, degree of motivation, and curiosity items from the clinician-rated Heinrichs-Carpenter Quality of Life Scale (QLS; Heinrichs et al., 1984). Although this index was originally presumed to measure intrinsic motivation, for the current investigation, we refer to it as a measure of general trait-like motivation instead of intrinsic motivation given that Choi, Choi, Reddy, & Fiszdon (Choi et al., 2014) found that this index may more aptly measure general trait-like motivation. Items on the motivation index are rated by trained clinicans on a 7-point (ranges from 0 to 6) scale, with higher scores indicative of greater motivation. Following the work of Choi et al. (2014), total index scores greater than or equal to 11 were considered to reflect high motivation. High motivation or a score of 11 was also chosen given that this score requires participants to receive individual QLS item scores that are near the upper end of the QLS rating scale and closer to being "normal or unimpaired" (Heinrichs et al., 1984, p. 389). This score was also chosen because it was near the top ten percent of motivation scores in the current sample. Several previous studies have used the motivation index with schizophrenia samples (c.f., Choi et al., 2014; Gard et al., 2009; Horan et al., 2015; Vohs et al., 2013), and it has demonstrated adequate construct, discriminant, and predictive validity as well as internal consistency, inter-rater reliability, and test-retest reliability (Fervaha et al., 2015b; Mueser et al., 2016; Nakagami et al., 2010; Nakagami et al., 2008; Saperstein et al., 2011).

Procedure

Once written informed consent was obtained from participants, clinical psychologists met with participants to confirm diagnoses with the SCID. Trained (inter-rater reliability > 0.70 on all study measures) master's-level research assistants then administered the IPII and QLS. Raters of the MAS-A were blind to all other testing. Procedures were approved by the local Institutional Review Boards.

Analyses

To test our hypothesis that metacognition is a necessary condition for motivation, we conducted a Necessary Condition Analysis (NCA; Dul, 2016b). This approach involves creating a scatterplot using the NCA package, version 2 (Dul, 2016c) in R, version 3.3.1 (R Core Team, 2016) to first identify the overall shape of the relationship between the independent variable (i.e., metacognition) and the dependent variable (i.e., motivation). A necessary condition is presumed to be present if the scatterplot contains an empty upper-left corner (Karwowski et al., 2016; Vis et al., In press), as this would indicate that there were no (or very few; see discussion of ceiling line techniques below) people with high motivation and low metacognition (Karwowski et al., 2016). The NCA also draws a ceiling line ($Y = f(X)$) that divides the scatterplot into two areas: one with and one primarily without data points (Dul, 2016b). If a necessary condition was present through visual inspection, we examined the ceiling line to identify the level of metacognition needed for high motivation to be possible. The ceiling line indicates the constraints that the independent variable has on the dependent variable, or in other words, the minimum level of the independent variable that is necessary for a given level of the dependent variable to be possible (Dul, 2016b; Vis et al., In press).

There are two main recommended techniques to create ceiling lines with the NCA package (Dul, 2016b), but this study focuses on the Ceiling-Regression-Free Disposal Hull (CR-FDH; Dul, 2016b) because it is the recommended technique for interpreting necessary conditions with continuous data (Dul, 2016a). The CR-FDH technique creates a non-decreasing linear function that smooths the non-decreasing step function created by the second recommended technique, the Ceiling Envelopment-Free Disposal Hull (CE-FDH) (Karwowski et al., 2016; van der Walk, 2016). Specifically, the CR-FDH technique draws an ordinary least squares regression trend line through the most upper-left data points in the scatterplot. However, since the CR-FDH is a smoothing technique and creates a straight ceiling line, it allows some data points to be above the ceiling line. Notably, both of these ceiling techniques differ from traditional regression approaches where a best estimate average line is drawn through the middle of the data points (Dul, 2016b). The NCA package can also calculate a bottleneck table (Dul, 2016b) that identifies the levels of motivation that require a minimum level of metacognition (i.e., when there is a bottleneck). More specifically, the bottleneck table identifies the specific minimum level of metacognition needed for different levels of motivation.

Finally, the NCA package creates an effect size for a necessary condition. The effect size is the size of the ceiling zone divided by the scope (i.e., the entire area where data points are possible when considering the minimum and maximum levels of the independent and

dependent variables (Dul, 2016b)). The larger the effect size, the greater the extent the independent variable is needed for the dependent variable or, in this case, the extent that metacognition constrains motivation (Vis et al., In press). Effect sizes were interpreted based on Dul's (2016b) recommendations where an effect size of $0 < d < 0.1$ is a small effect, $0.1 \leq d < 0.3$ is a medium effect, $0.3 \leq d < 0.5$ is a large effect, and $d \geq 0.5$ is a very large effect.

Results

Descriptive statistics for the study measures are presented in Table 1.

NCA Analyses

Figure 1 contains the scatterplot between the overall metacognition score and the motivation index. The scatterplot contains a relatively empty upper-left corner above the CR-FDH ceiling line, suggesting that a necessary condition is present. Further, the effect size for the necessary condition was medium ($d = .10$). The CR-FDH ceiling line and the bottleneck table (Table 2) also indicate that high motivation was only possible if a person had an overall metacognition score that was greater than or equal to 9.38. However, as seen in the scatterplot, while this metacognition score is necessary to obtain high motivation, it is not sufficient for high motivation to occur. In other words, without this level of metacognition, high motivation is guaranteed not to happen, but the presence of this level of metacognition does not automatically guarantee high motivation will be present (Vis et al., In press). For example, in Figure 1, there are three people with an overall metacognition score of twenty-two (i.e., above the minimum level needed for high metacognition) who also have motivation scores less than 11. Further, while 65% of our sample had a score of 9.38 or greater, only 10% of our sample had high motivation. Thus, overall metacognition scores above 9.38 make possible but do not necessarily guarantee high motivation will occur.

To identify what domains of metacognition were necessary for motivation, we also conducted a NCA with each of the four domains of metacognition. The scatterplots for self-reflectivity (see Figure 2), sense of other (see Figure 3), and mastery (see Figure 4) all indicated that a necessary condition was present. However, the scatterplot for decentration (see Figure 5) did not indicate that a necessary condition was present, as the upper-left corner contained a number of data points. These findings were consistent with the necessary condition effect sizes, as the effect sizes were small for self-reflectivity ($d = .09$), sense of other ($d = .03$), and mastery ($d = .06$), while the effect size for decentration confirmed that there was no necessary condition present ($d = 0.00$). The CR-FDH ceiling line and bottleneck table indicate that in order for high motivation to be possible, the minimum levels of each metacognition domain necessary are as follows: self-reflectivity = 3.30, sense of other = 1.00, and mastery = 1.92; however, similar to overall metacognition, these levels are necessary although not sufficient for high motivation to occur. Of note, given that the metacognition domain data may also be considered discrete, we confirmed that the results were similar using the CE-FDH ceiling line technique.

Discussion

The functional significance of motivation has spurred a need to identify the underlying mechanisms and determinants of motivation in people with schizophrenia spectrum disorders. To date, decreased metacognition has been found to be one contributor to reduced motivation (Luther et al., 2016a; Vohs et al., 2014). This study sought to identify whether metacognition is in fact a necessary condition (i.e., a prerequisite) for motivation to occur. More specifically, if metacognition was a necessary condition for motivation, we sought to identify if there is a minimum level of metacognition that must be present in order for high motivation to be possible in people with schizophrenia spectrum disorders. In line with our hypothesis, we found that overall metacognition was a necessary condition for motivation, representing a medium effect size. We also observed that one must display at least a basic level of overall metacognitive capacity (i.e., an overall metacognition score of 9.38 or more) in order for high motivation to be possible. However, we also found that a basic level of overall metacognitive capacity did not guarantee high motivation. Alternatively, our results indicate that a person with less than a basic level of metacognitive capacity cannot have high motivation. In other words, a basic level of overall metacognitive capacity was a prerequisite for but did not guarantee that high motivation would be present.

One interpretation of these findings is that metacognition is a necessary, although not sufficient, building block for trait-like motivation to emerge in people with schizophrenia spectrum disorders. It is possible that an integrated sense of oneself and others is necessary for guiding and supporting high levels of goal directed behavior. Without this integrated representation, it may be difficult to use information about oneself to formulate meaningful goals or methods of obtaining them (McGuire et al., 2015). Further, without metacognition, it may be hard to differentiate or question inaccurate or maladaptive thoughts about oneself, others, or the world that can hinder goal directed-behavior. However, it is also likely that an integrated sense of oneself and others is not entirely responsible for the emergence of motivation. Indeed, consistent with our finding that at least a basic metacognitive capacity is needed but does not guarantee that high motivation will occur, it is also possible to imagine a person with high metacognitive capacity but little motivation to complete school or work activities due to environmental factors or a lack of autonomy and competence (Ryan et al., 2000).

Similarly, our results also suggest that other factors may be important for the development of high motivation in people with schizophrenia spectrum disorders. Although 65% of the sample reached the overall metacognition threshold (i.e., score of 9.38), only 10% of our sample had high motivation. For those that have the necessary metacognition threshold for high motivation but still have low motivation, it may be that other factors or necessary conditions are not in place. Given that schema-driven expectations about self and others (Dimaggio et al., 2015; Luther et al., 2015b; Medalia et al., 2010) and the basic psychological needs of autonomy, competence, and relatedness (Gard et al., 2014; Ryan et al., 2000) are important for motivation in schizophrenia, future work may benefit from examining whether these constructs are also necessary conditions for high motivation to occur in people with schizophrenia spectrum disorders. For example, even in the presence of a basic level of metacognition, including the awareness of one’s mental experiences and

goals, negative expectations about one's ability to succeed or perform may thwart goal-directed behavior (Dimaggio et al., 2015).

We also explored whether there were specific metacognition domains that were necessary conditions for motivation. The domains of self-reflectivity, sense of other, and mastery were all necessary conditions for motivation, with small effect sizes, while decentration was not a necessary condition for motivation. These findings are consistent with and build on prior findings indicating that lower self-reflectivity, mastery, and sense of other are associated with lower motivation (Tas et al., 2012; Vohs et al., 2014). Specifically, our findings suggest that in order for high motivation to be possible, a person may need to have at minimum an ability to recognize and distinguish between their mental activities such as thoughts and emotions as well as have some beginning sense of different nuanced emotions (i.e., self-reflectivity). Further, people need to have a beginning awareness that other people have mental experiences (i.e., sense of other), as well as have the capacity to identify a plausible psychological problem they are experiencing (i.e., mastery). Decentration, or the capacity to recognize that events can be understood from different perspectives (Lysaker et al., 2015), on the other hand, is not necessary for the presence of high motivation. Taken together, these findings suggest that multiple domains of metacognition, but not all, are necessary conditions for high motivation to occur.

A strength of this study was the use of a novel statistical approach to more decisively identify whether certain levels of metacognition are a prerequisite in order for certain levels of motivation to emerge. These findings are consistent with prior analyses and studies that identified whether on average, higher levels of metacognition lead to higher levels of motivation in people with schizophrenia (Luther et al., 2016a; Luther et al., 2016b; Tas et al., 2012; Vohs et al., 2014). Notably, our findings build on these prior studies by identifying the *specific level* of metacognition necessary to enable high motivation. Although the NCA analytic method is a newer approach (Dul, 2016b; van der Valk et al., 2016), it offers vast potential to identify critical conditions needed for real-world outcomes such as obtaining a job or participating in the community. To date, this approach has largely been used in the management literature (van der Valk et al., 2016; van der Valk et al., 2012; Westerhuis, 2012) and recently to identify that intelligence is a necessary condition for creativity (Karwowski et al., 2016). Future work could use the NCA method to examine the level of additional processes that may be necessary for specific levels of motivation to occur among persons with schizophrenia.

There are also several limitations that should be considered when interpreting these findings. First, although a strength of the study was the sample size, the majority of participants in the sample were men engaged in outpatient services. Thus, it may be that the identified minimum levels of metacognition needed for high motivation to be possible differs in females and/or those not engaged in treatment. Further, although the NCA analysis suggests that metacognition may be a causal mechanism for motivation, no definitive causal conclusions can be drawn given the cross-sectional nature of this study. Finally, since prior work has suggested that a general trait-like level of motivation might not be needed to develop specific domains of motivation such as intrinsic motivation (Choi et al., 2014),

future studies could also examine whether similar levels of metacognition are needed for different domains of motivation.

Conclusions

In conclusion, this study uses a novel statistical approach to examine whether metacognition is a necessary condition for motivation to occur in people with schizophrenia spectrum disorders. Our findings suggest that metacognition is in fact a necessary prerequisite for the development of motivation. We found that high motivation was only possible, although not guaranteed, if at least a basic level of metacognition was present. These findings provide converging evidence for the importance of targeting metacognition as a means to improve motivation deficits in people with schizophrenia spectrum disorders. Targeting metacognition may be particularly important for people that have low motivation and metacognition levels below the necessary threshold for high motivation, as our findings suggest that motivation may not increase to high levels unless basic metacognitive capacities are present. Indeed, our findings indicate that targeting other determinants of motivation may not lead to high motivation unless basic metacognitive capacities are present. Thus, clinicians trying to enhance motivation can use these findings to determine if metacognition should be targeted first to improve motivation among persons with schizophrenia spectrum disorders.

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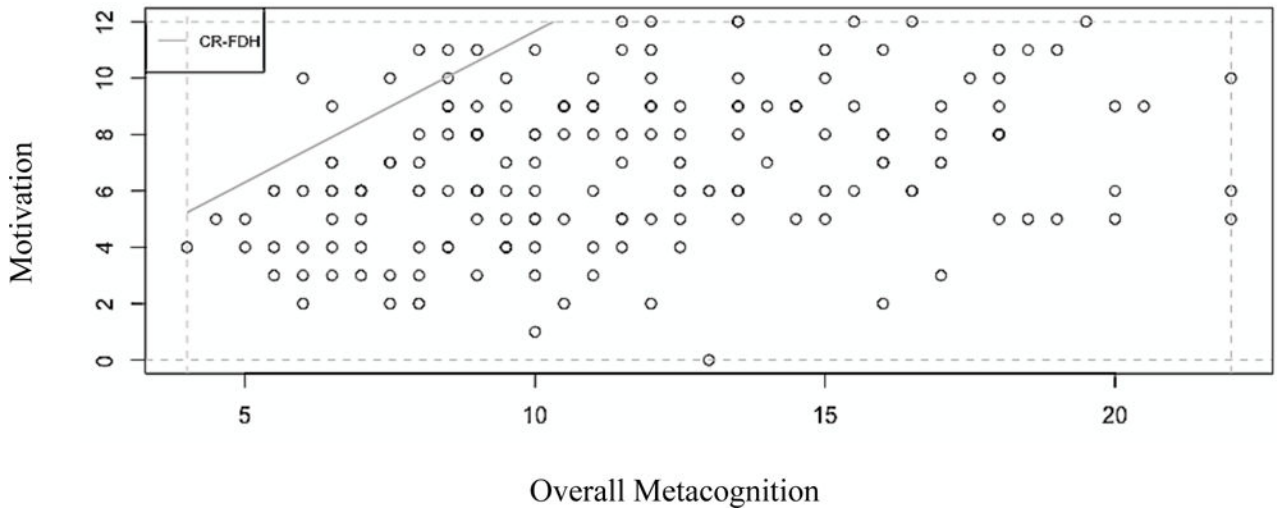

Figure 1.
NCA scatterplot of the relationship between overall metacognition and motivation (n = 175).

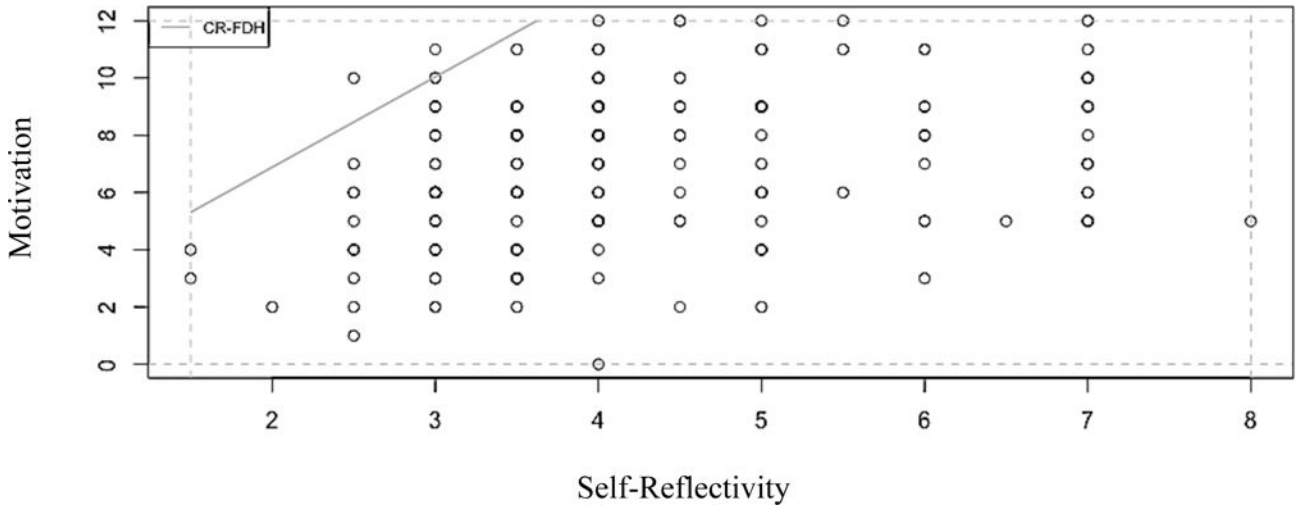

Figure 2.
NCA scatterplot of the relationship between self-reflectivity and motivation (n = 175).

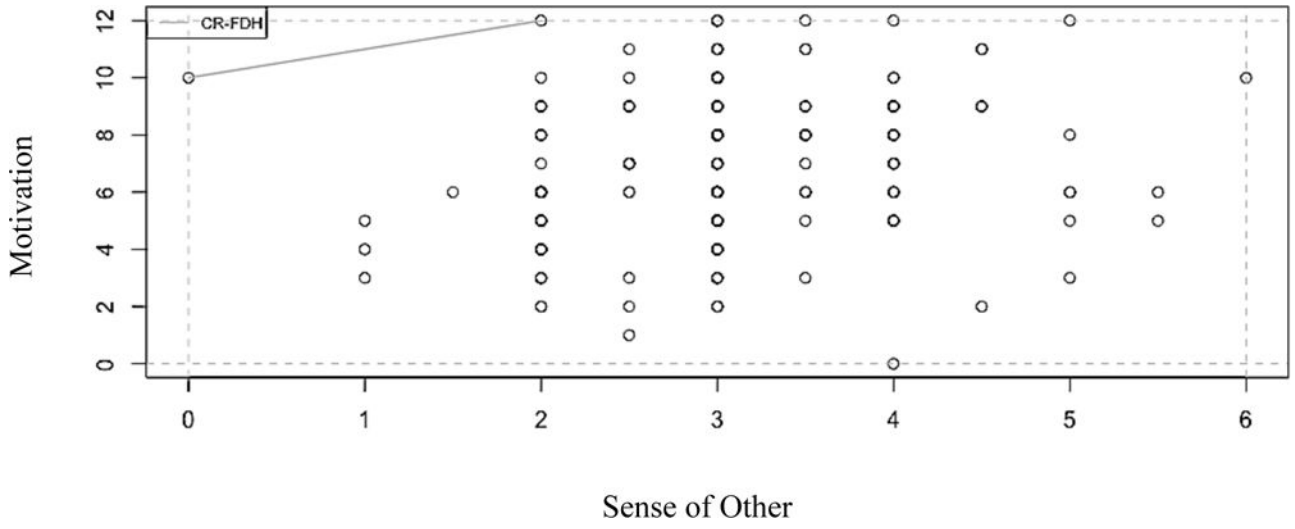

Figure 3.
NCA scatterplot of the relationship between sense of other and motivation (n = 175).

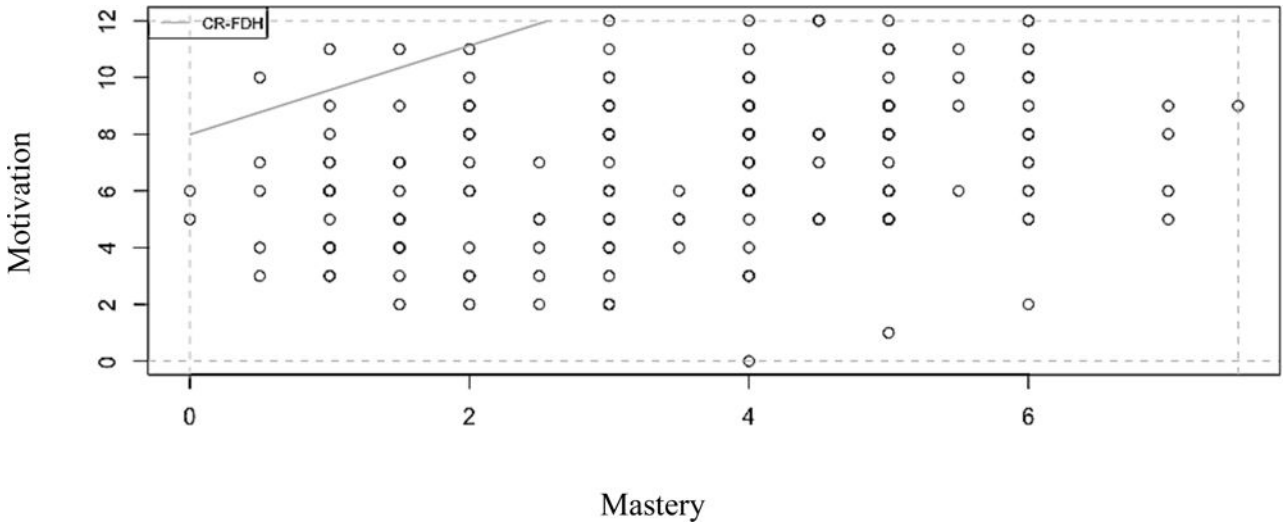

Figure 4.
NCA scatterplot of the relationship between mastery and motivation (n = 175).

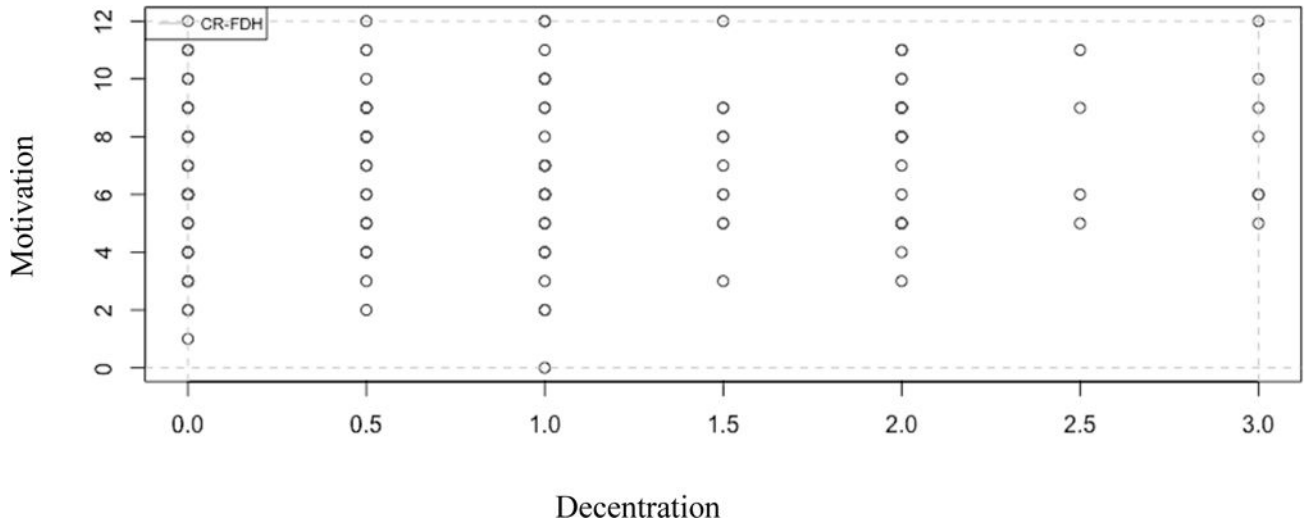

Figure 5.
NCA scatterplot of the relationship between decentration and motivation (n = 175).

Table 1

Means, standard deviations, and observed ranges for metacognition and motivation variables (n = 175).

Variable	Mean (SD)	Observed Range
MAS-A – Self-reflectivity	4.21 (1.37)	1.5–8
MAS-A – Awareness of other's mind	3.03 (0.92)	0–6
MAS-A – Decentration	0.82 (0.85)	0–3
MAS-A – Mastery	3.49 (1.75)	0–7.5
MAS-A – Total score	11.54 (4.15)	4–22
QLS – Motivation	6.85 (2.67)	0–12

Note: MAS-A = Metacognition Assessment Scale–Abbreviated; QLS = Quality of Life Scale.

Table 2

Bottleneck table indicating the required minimum levels of metacognition needed for different levels of motivation.

Motivation	Overall metacognition	Self-reflectivity	Sense of other	Mastery
0.00	NN	NN	NN	NN
1.00	NN	NN	NN	NN
2.00	NN	NN	NN	NN
3.00	NN	NN	NN	NN
4.00	NN	NN	NN	NN
5.00	3.79	1.40	NN	NN
6.00	4.72	1.72	NN	NN
6.50	5.18	1.88	NN	NN
7.00	5.65	2.04	NN	NN
7.50	6.12	2.19	NN	NN
8.00	6.58	2.35	NN	NN
8.50	7.05	2.51	NN	0.33
9.00	7.52	2.67	NN	0.65
9.50	7.98	2.83	NN	0.97
10.00	8.45	2.99	NN	1.28
10.50	8.92	3.15	0.50	1.60
11.00	9.38	3.30	1.00	1.92
11.50	9.85	3.46	1.50	2.24
12.00	10.32	3.62	2.00	2.56

Note: NN = not necessary; motivation levels where metacognition is not a necessary condition. Decentration was not included because it is not a necessary condition for motivation.